

# **NAVAL POSTGRADUATE SCHOOL**

## **Monterey, California**



## **PH 3052**

**RADARSAT Antarctica Mapping Mission**

by

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## **Introduction**

This assignment examines from an IT perspective the RADARSAT mission to collect data and map the Antarctic continent. For 18 days during the Southern Hemisphere spring of 1997, a NASA-launched Canadian satellite called RADARSAT collected pieces of a puzzle that will help scientists study the most remote and inaccessible part of the Earth -- Antarctica. Scientists now have the puzzle pieces put together, forming the first high-resolution radar map of the mysterious frozen continent. "This map is truly a new window on the Antarctic continent, providing new beginnings in our Earth science studies there," said Dr. Ghassem Asrar, Associate Administrator for Earth Science, NASA Headquarters, Washington, DC. The new map was produced as part of NASA's Antarctic Mapping Project.

## **Background on Radarsat**

RADARSAT was developed under management of the [Canadian Space Agency](#) (CSA) in cooperation with the [National Aeronautics and Space Administration](#) / [National Oceanic and Atmospheric Administration](#) (NASA/NOAA), Canadian provincial governments, and the Canadian private sector. NASA and NOAA launched RADARSAT in exchange for access to data and private sector participation in data distribution. In 1976, Canada recognized the need for its own radar satellite to provide better surveillance of the Canadian North. A radar satellite was required because of long periods of darkness during the winter months in the High Arctic. In addition, Canada has approximately 240,000 km of coastline, which are often enshrouded in fog and haze--conditions that make it difficult to collect usable data if optical satellites are used. RADARSAT was designed to penetrate cloud and haze and to meet operational requirements for collecting data over vast land masses in Canada and around the world.

## **General Characteristics: RADARSAT 1**

- C-band synthetic aperture radar (SAR).
- Launched November 4, 1995. Five-year design life.
- RADARSAT-2 to be launched in 2002.
- Cloud-free images of the Earth.
- 7 beam modes offering a wide range of:
  - Resolutions (8 - 100 meters)
- Swath Widths (50 - 500 km)
- Incidence Angles (10 - 59 degrees)
- Revisit time for the Antarctica mission approximately 0.5-1 day in length.

### **Data Handling System**

RADARSAT's SAR does not collect data continuously. The satellite is programmed to use specific beam positions only when a request to collect data has been made. The payload computer can store 20 beam positions at one time and is programmed to define which of these are accessible. It can be reprogrammed if a user request for a different beam position is made. As the RADARSAT data is collected, either it is transmitted to a participating ground receiving station or it is stored on a high density, digital, rotary-head tape recorder and later down linked to a ground station. Real-time and tape-recorded downlinks can be executed simultaneously through two X-band RF links. During the Antarctica mapping mission RADARSAT collected 43 hours worth of data during the 18-day mission. Approximately 8.8 terabits of data was stored on the tape recorders and transmitted to ground sites as the satellite passed over ground stations in Canada and Alaska. This data filled approximately 31 digital tape cartridges.

In Canada, there are three data reception and processing facilities located in Gatineau, Quebec (GSS); Prince Albert, Saskatchewan (PASS), and Fairbanks, Alaska. When collecting data using the on-board recorder (OBR) instead of a real-time data acquisition, there was reduced swath coverage because of bandwidth limitations of the OBR. There are two OBR's only one OBR is used at a time; the second is a back up. Each OBR can store 10 minutes of SAR data per orbit. The tape recorder is capable of playing the signal back at a rate of 85 Mb/s (compared to the real-time downlink of 105 Mb/s). As soon as the network station is within range, data can be 'down linked'. Data can then be delivered within hours of reception at the RADARSAT network station to clients worldwide, (i.e., NASA Goddard Space Flight Center).

### **Summary**

The mapping of the Antarctica by RADARSAT gave scientist highly detailed maps of a region of earth, which is nearly impossible to map with terrestrial means. RADARSAT also enabled an accurate mapping of the ice condition in Antarctic waters and can monitor changes in these conditions. This ability has utility to the Naval community in that an accurate mapping of these polar waterways can provide naval forces the ability to safely access and operate in these regions.

**References:**

[http://www.rsi.ca/classroom/cl\\_rsate.htm](http://www.rsi.ca/classroom/cl_rsate.htm) Radarsat Interactive

<http://svs.gsfc.nasa.gov/imagewall/antarctica.html> NASA Goddard Space Flight Center, Scientific Visualization Studio, Antarctica Mapping Project.

Brakenridge, R. G., Remote Sensing of Surficial Process Responses to Extreme Meteorological Events, National Aeronautics and Space Administration; National Technical Information Service; Springfield, Va. 1997.

Figure 1

A composite radar map of Antarctica, produced by the RADARSAT satellite during the mapping mission conducted during 1997.

